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EM100 Ethernet-to-serial Module



The EM100 is an Ethernet Module for onboard installation. Module hardware includes one 10BaseT Ethernet port (standard Ethernet magnetics are **integrated** into the Module), one serial port (CMOS-level) with a number of additional general-purpose I/O lines, and an internal processor, whose firmware acts as a bridge between the Ethernet and serial ports. Ethernet "side" of the Module connects directly to a standard RJ45 connector. Serial "side" interfaces directly to the serial port pins of most microcontrollers, microprocessors, UARTs, etc.

From the hardware standpoint, the EM100 can be viewed as a universal platform suitable for running a variety of network and serial communications-related applications. It is the application firmware, not hardware that gives the EM100 most of its functionality.

The [Application firmware](#) EM100 is supplied with, currently in its 3rd generation ("Release3"), turns the EM100 into a Serial Device Server used to connect serial devices to the Ethernet (TCP/IP) networks.

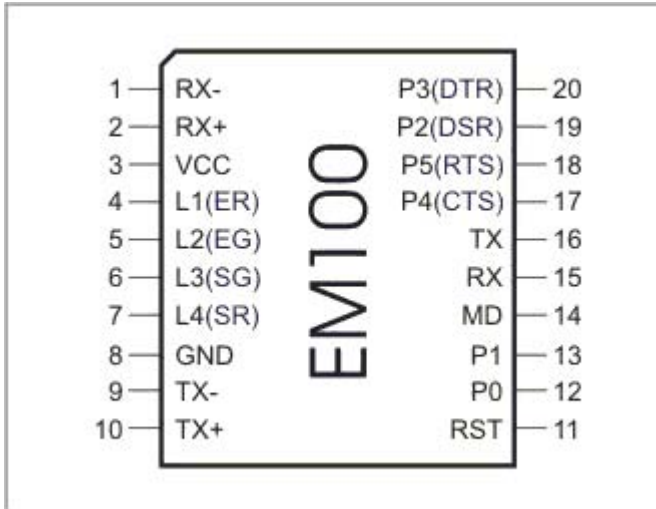
The application firmware of the EM100 can be upgraded through the module's serial port or Ethernet port*. Serial upgrades are facilitated by a so-called [Monitor](#)- a fixed "service" firmware inside the EM100. The Monitor itself cannot be upgraded. Network upgrades rely on the [NetLoader](#) firmware component that, like the application firmware itself, can be upgraded through the serial port of the EM100 (using the Monitor). The EM100 is supplied with the application firmware and the NetLoader already pre-loaded into the module.

Since most of the EM100's operation is defined by its firmware the major part of the EM100's functional description can be found in the [Device Server Application Firmware Manual](#). This *EM100 Ethernet Module Manual* focuses on the hardware portion of the EM100.

* *Network upgrades are only possible on the latest EM100-03 modification of the device (see [specifications and EM100 modifications](#) for details)*

I/O pin assignment and pin functions

EM100 pin assignment is shown below.



Click on the pin in the diagram above or one of the links provided below to learn more about EM100's I/O pins:

- [Ethernet port lines](#)
- [Serial port and general-purpose I/O lines](#)
- [LED lines](#)
- [Power, reset, and mode selection lines](#)

Ethernet port lines

#10	TX+	Output	Positive line of the differential output signal pair
#9	TX-	Output	Negative line of the differential output signal pair
#2	RX+	Input	Positive line of the differential input signal pair
#1	RX-	Input	Negative line of the differential input signal pair

Ethernet port of the EM100 is of 10BaseT type. The EM100 is compatible with all 10BaseT Ethernet hubs and also 99% of 100BaseT hubs. This is because most 100BaseT hubs are actually 100/10 machines that auto-detect the type of device connected to each port.

The EM100 is designed to attach directly to the RJ45 Ethernet connector. Standard magnetics circuitry (YCL part 20F001N) has been included onboard to provide a "glueless" interface to the Ethernet network.

It is important to make the PCB wire connections between the Ethernet port pins and the RJ45 as short as possible. Making the wires too long may cause the noise level generated by your PCB surpass the maximum radiated emission limits stipulated by FCC and CE regulations. Additionally, longer Ethernet lines on the PCB will make your board more susceptible to the damage from the ESD (electrostatic discharge).

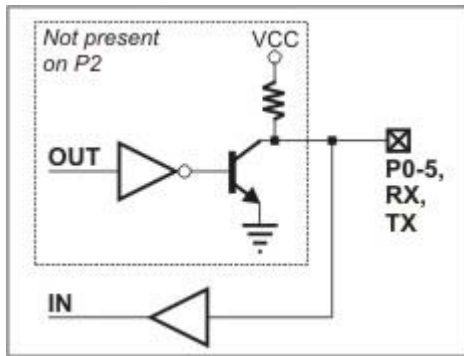
Serial port and general-purpose I/O lines

#16	TX	Output	Serial transmit line
#15	RX	Input	Serial receive line
#18	P5 (RTS/DIR)	Input/output (output)	General-purpose input/output line Request to send output (full-duplex mode) Data direction control output (half-duplex mode)
#17	P4 (CTS/SEL)	Input/output (input)	General-purpose input/output line Clear to send input Full-/half-duplex selection input
#20	P3 (DTR)	Input/output (output)	General-purpose input/output line Data terminal ready output
#19	P2 (DSR)	Input (input)	General-purpose input line Data set ready input
#13	P1	Input/output	General-purpose I/O line
#12	P0	Input/output	General-purpose I/O line

Line functions defined by the [application firmware](#) are shown in **blue**

The EM100 features a serial port (RX, TX lines) and several general-purpose I/O lines (P0-P5). All of the above lines are of CMOS type. From the hardware point of view, all general-purpose I/O lines except P2 can serve as inputs or outputs. Line P2 can only work as an input. Maximum load current for all CMOS lines is 10mA.

Simplified structure of EM100's I/O lines is shown on the circuit diagram below. All lines are "quasi-bidirectional" and can be viewed as open collector outputs with weak pull-up resistor. There is no explicit direction control. To "measure" an external signal applied to a pin the OUT line must first be set to HIGH. It is OK to drive the pin LOW externally when the pin outputs HIGH internally.



The [application firmware](#) of the EM100 maps certain serial port functions onto the general-purpose I/O pins- these functions are shown in blue in the table at the top of this topic. For example, P5 is a universal input/output but the application firmware can be set to turn this line into the RTS output of the serial port. Therefore, depending on your application you can view P5 as a general-purpose I/O line or specific control line of the serial port (RTS).

Being of CMOS type, the serial port and I/O lines of the EM100 can be connected directly to the serial port pins and I/O lines of most microcontrollers, microprocessors, etc. An interface IC* must be added to the EM100 externally if you want to connect the module to a "true" serial port (for example, COM port of the PC).

Logical signals on the serial port lines of the EM100 are active LOW. TX and RX lines are high when idle, start bit is LOW, stop bit is HIGH; LOW on CTS and RTS lines means "transmission allowed" and HIGH means "transmission not allowed". This is standard for CMOS-level serial ports and is exactly opposite to the signalling on the RS232 cables. Logical signals on the EM100 are inverted because standard interface ICs* invert the signals internally too.

As explained earlier, actual functionality of the I/O lines is firmware-dependent. See [serial port and serial communications](#) for details.

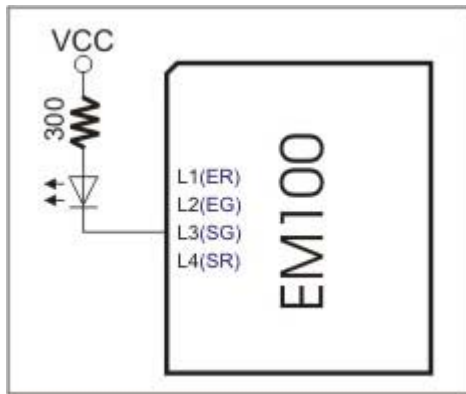
* Such as MAX232 for RS232, MAX485 for RS485, etc.

LED lines

#4	L1 (ER)	Output	LED output 1, Red Ethernet status LED
#5	L2 (EG)	Output	LED output 2, Green Ethernet status LED
#6	L3 (SG)	Output	LED output 3, Green status LED
#7	L4 (SR)	Output	LED output 4, Red status LED

Line functions defined by the [application firmware](#) are shown in **blue**

The EM100 has four LED control lines. All lines have the same internal structure and the LEDs should be connected to these lines as shown on the schematic diagram below. Maximum load for each line is 10mA.



The firmware of the EM100 assigns specific functions to these LED control lines- these functions are shown in blue in the table at the top of this topic.

ER and EG lines reflect the status of the Ethernet port. The EG LED is normally ON, and is temporarily turned off whenever the EM100 receives a network packet. The ER is normally OFF, and is temporarily turned on whenever a data collision is detected on the Ethernet*.

The SR and SG LEDs display various status information depending on what firmware is running at the moment. Follow the links below to learn more about the behaviour of these LEDs under different conditions:

- [SR/SG behavior in the monitor firmware.](#)
- [SR/SG behavior in the NetLoader.](#)
- [SR/SG behavior in the application firmware.](#)

* *Strictly speaking, the ER and EG lines are under firmware control. Their behavior is described here because they are always made to work as standard Ethernet status LEDs (like the ones found next to the RJ45 connector on the PC network cards).*

Power, reset, and mode selection lines

#3	VCC		Positive power input, 5V nominal, +/- 5%, app. 40mA
#8	GND		Ground
#11	RST	Input	Reset, active high
#14	MD (MD)	Input	Mode selection pin

Line functions defined by the [application firmware](#) are shown in **blue**

The EM100 should be powered from a stabilized DS power supply with output nominal voltage of 5V (+/- 5% tolerance). Current consumption of the EM100 is approximately 40mA.

Proper external reset is a must! Reset pulse should be an active HIGH. We strongly advise against using low-cost RC-networks and other unreliable methods of generating reset pulse. Reset should be applied for as long as the power supply voltage is below 4.6V. We recommend using a dedicated reset IC with brownout detection, such as MAX810. Reset pulse length should be no less than 50ms, counting from the moment the power supply voltage exceeds 4.6V.

If the EM100 is used to serve as a communications co-processor in a larger system that has its own CPU it is also OK to control the RST line of the EM100 through a general-purpose I/O pin of the "host" microcontroller. I/O pins of many

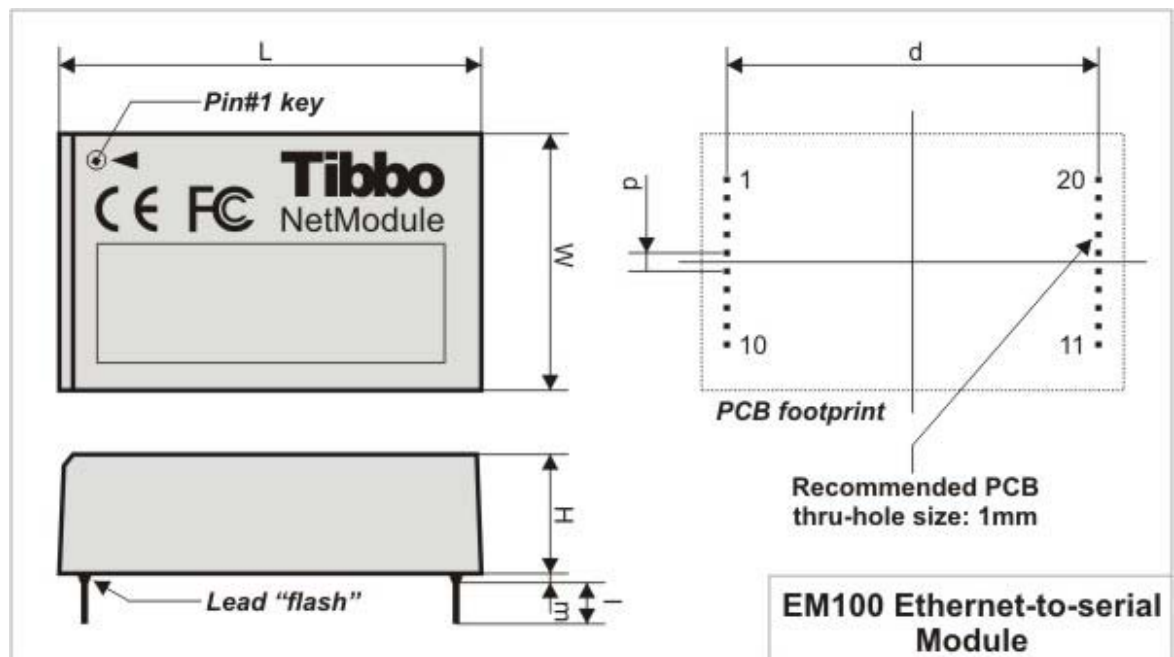
microcontrollers default to HIGH after the powerup and this means that the reset will be applied to the EM100 at the same time when the host microcontroller is reset. All the host microcontroller has to do is release the EM100 from reset at an appropriate time by switching the state of the I/O line to LOW.

The MD line of the EM100 is used to select the operating mode of the EM100 and/or its application firmware. The reason why the pin name is shown as MD(MD) is because the functionality of this pin is in part hardwired and in part depends on the [application firmware](#):

- **Hardwired functionality.** When the EM100 powers up it verifies the state of the MD input. If the MD input is at HIGH the EM100 proceeds to verifying and running the application firmware loaded into its internal FLASH memory. If the MD input is at LOW the EM100 enters the serial upgrade mode. For more information see [Monitor](#).
- **Application firmware-dependent functionality.** When the [application firmware](#) is already running the MD line is typically used to make the EM100 enter the serial programming mode. For more information see [serial programming](#).

When the EM100 is used as a co-processor in a host system the MD line can be also controlled by the host microcontroller. Ability to control both the RST and DS lines allows the host microcontroller to switch between the operating modes of the EM100.

Mechanical dimensions



L	Max.	46.2	Module length
W	Max.	28.0	Module width
H	Max.	13.0	Module height
I	Min.	4.5	Lead length
m	Max.	1.0	Lead "flash"
d	Aver.	40.6	Distance between lead rows
p	Aver.	2.0	Pin pitch

All dimensions are in millimeters

Specifications and EM100 modifications

The EM100 has had three modifications, so there are four different EM100 submodels in circulation: EM100-00, EM100-01, EM100-02, and EM100-03. Currently, only the EM100-03 is being manufactured so the information on EM100-00, EM100-01, and EM100-02 is provided for your reference only.

The EM100-00, EM100-01, and EM100-02 devices were basically the same, with only the minor changes made to the internal hardware (such as bypass capacitors on the internal PCB, etc.). We will refer to all three modifications as EM100-02.

The EM100-03 has extended functionality compared to the EM100-02. There are two notable differences:

- Memory size inside the device has been increased so the [routing buffers](#) of the EM100-03 are double the size of the buffers inside the EM100-02 (510 bytes in each direction vs. 255 bytes in each direction).
- Ability to upgrade the [application firmware](#) through the network was added (this is facilitated by the [NetLoader](#) firmware) to the EM100-03. The EM100-02 cannot run the NetLoader and cannot be upgraded through the network.

Apart from the above differences all EM100 modifications are fully compatible with each other*.

Device specifications are presented in the table below.

Parameter	EM100-03 (EM100-00/01/02)
Ethernet interface	10BaseT Ethernet, standard magnetics built-in
Serial interface and I/O lines	CMOS-level; TX, RX, and 6 additional I/O lines with RTS, CTS, DTR, DSR implemented in application firmware
Routing buffers size	510 bytes x 2 (255 bytes x 2)
Maximum load current of I/O lines	10mA
Power requirements	DC 5V, +/- 5%, app. 40 mA
Operating temperature	-10 to +70 degrees C
Operating relative humidity	10-90%
Mechanical dimensions (excl. leads)	46.2x28x13mm
Packing	Plastic tray, 30 modules/tray

* On the functional level, the application firmware files to be loaded into the devices are different!

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